

SECTION 20 72 25
FACTORY AND FIELD TESTING

Part 1 – GENERAL

1.01 SECTION INCLUDES

- A. Requirements for factory and field testing for equipment, devices and systems as specified in the following Contract Specifications Divisions:

1. Division 14 – Conveying Equipment.
2. Division 21 – Fire Suppression.
3. Division 22 – Plumbing.
4. Division 23 – Heating, Ventilating and Air Conditioning.
5. Division 26 – Electrical.
6. Division 27 – Communications.
7. Division 28 – Electronic Safety and Security.
8. Division 34 – Transportation.

1.02 RELATED SECTIONS

- A. Section 01 32 16, Project Progress Schedules
- B. Section 01 33 00, Submittal Procedures
- C. Section 01 43 00, Quality Assurance
- D. Section 01 45 00, Quality Control
- E. Section 01 52 00, Construction Facilities
- F. Section 20 80 00, Systems Integration Testing
- G. Section 34 21 05, Prefabricated DC and AC Houses
- H. Section 34 21 80, TP System Field Acceptance Testing

1.03 GENERAL REQUIREMENTS

- A. Test requirements for individual items of equipment, devices, or systems are covered within the Contract Specifications of those components or systems; these include Contract Specifications Divisions 14, 21, 22, 23, 26, 27, 28, 33, or 34.

Systems integration testing is covered in Contract Specifications Section 20 80 00, Systems Integration Testing.

- B. Develop test procedures, perform tests, and document test results, as specified herein. The Contractor shall have an approved test procedure before starting the applicable tests.
- C. Quality assurance and control are specified in Contract Specifications Section 01 43 00, Quality Assurance and Section 01 45 00, Quality Control.
- D. Prepare all submittals in accordance with Contract Specifications Section 01 33 00, Submittal Procedures.

1.04 **TEST RESPONSIBILITY**

- A. Perform all factory and field tests that are specified as the Contractor's responsibility. Provided support for District testing as specified; however, the Contractor will not be responsible for any other aspect of District testing. Tests shall be performed by the Contractor, the equipment manufacturer, or an accredited testing laboratory as approved by the District. Although District personnel will witness Contractor testing, the Contractor shall be responsible for planning, scheduling, and performing the tests.
- B. All factory and field-testing shall be conducted under the direction of the Contractor's System's Integration Manager. Individual subcontractor test directors shall report directly to the System's Integration Manager.
- C. Furnish all test instruments and any other equipment and materials necessary to perform the tests.
- D. Acceptance of the structures, facilities, and equipment provided under the Contract is contingent upon successful compliance with inspection and test requirements. These tests shall demonstrate the performance of the equipment at various points in the design, manufacturing, and installation process.
- E. The Contractor shall be held fully responsible for the repair or replacement of equipment damaged as a result of tests and shall bear all associated costs.

1.05 **TEST PLAN AND SCHEDULE**

- A. Within six months of NTP, submit a schedule of all factory and field test types that are proposed for all tests as specified in Contract Specifications Divisions 14, 21, 22, 23, 26, 27, 28, 33, or 34 and Contract Specifications Section 20 80 00, Systems Integration Testing. Utilize the schedule format shown in the attachment to this Contract Specifications Section.
- B. For each system or subsystem, prepare and submit eight copies of a test plan to the District Representative for approval no later than the time of the system level design review for the applicable system or subsystem.

- C. The test plan shall list each test procedure that will be submitted by the Contractor to demonstrate compliance with the requirements of this Contract. The test plan shall contain a schedule with the date, location and duration for all tests, based on site availability forecasts and any sequencing requirements. The test plan shall also include:
1. An index describing each test with its procedure number and objectives.
 2. A list of applicable pre-requisites for each test.
 3. Test program personnel organization and responsibilities of each organization level.
 4. Test reporting methodology, including instructions for recording pertinent test conditions, identifying, evaluating, and correcting causes of problems or failures.
 5. Sample general test sheets and instructions for their use.
 6. Description of procedures for preparing and submitting test data sheets.
 7. Identification, where applicable, of primary test agency if other than the Contractor.
 8. General provisions for re-test as a result of either test failure or modification of equipment after test.
 9. Description of method used to schedule each test.
 10. Test plan revision procedure and controls.
- D. Testing Schedule: Submit a test schedule for District approval. The schedule shall include all specified tests for individual equipment, systems, subsystems, and systems integration testing.
1. The schedule shall be reflected in the Milestone Summary and Detailed Project Schedules as defined in Contract Specifications Section 01 32 16, Project Progress Schedules.
 2. Identify each test as follows:
 - a. Category (i.e. equipment, system, or integration test).
 - b. Number and title of test.
 - c. Constraining activities affecting test.
 - d. Location of test.
 - e. Projected duration of test.
 - f. Sequencing of tests, with emphasis on prerequisites.

1.06 TEST PROCEDURES

- A. Develop a written test procedure for each test identified in the test plan. Submit each test procedure to the District Representative for approval at least 60 Days before the start of the respective test. The test procedure shall include:
1. Test title and ID number.
 2. Statement, including diagrams where appropriate, identifying the equipment or systems to be tested, test objectives, and scope.
 3. Personnel required.
 4. Applicable industry standards.
 5. List of equipment required to perform the test. Test instruments shall be listed including manufacturer, model, type, and serial number.
 6. List of equipment, services, or facilities required from areas outside of the Contractor's authority, including identification of required District-furnished material, personnel, equipment, and facilities access.
 7. List of prerequisite tests.
 8. Description of the required test setup, including, but not limited to, diagrams illustrating test equipment connections and identifying test points.
 9. Step-by-step instructions for performing the test and identifying the points at which data will be recorded.
 10. Test constraints.
 11. Pass/fail criteria.
 12. Limits for acceptable data and an explanation of any special data reduction methods.
 13. Specific provisions for re-test as a result of either test failure or modification of equipment after test; and
 14. Test Data Sheets. Test data sheets shall identify the test, and shall be designed to include spaces to record test data, test date, and signatures of individuals performing and witnessing the tests. Data sheets shall be arranged in tabular form where practical. For each test procedure, provide general and specific data sheets.
 - a. General Test Data Sheets: General or generic test data sheets shall provide a template, or general layout, for all tests in a particular test category. General test data sheets can be prepared to apply in more than one test category. General data sheets shall include test identification, date or revision number, and spaces for check-off, discrepancies, and verification of the test's completion. Where applicable, general test data sheets shall include drawing

numbers, test equipment and their respective model numbers, references to the applicable procedure number, allowable limits for certain entries, and corrective actions required.

- b. Site-Specific Test Data Sheets: Site-specific test data sheets shall contain all the information for each test category and each test condition pre-filled out. Test data sheets incorporating site-specific information shall be filled out and submitted to the District 10 Days prior to conducting test. Data entries shall be referenced to the applicable procedure, and allowable limits for each entry shall be indicated on the data sheets.

1.07 TEST NOTIFICATION AND WITNESSING

- A. Notify the District Representative and all participating parties 30 Days before the scheduled start of tests. The District reserves the right to witness all tests or appoint an independent agency as a test witness representative. The witness(es) will be present on a non-interfering and non-participatory basis. All witnessing parties shall sign the test reports; however, their signature(s) shall not constitute a guarantee or endorsement of the tests or results.

1.08 TEST SUPPORT DOCUMENTATION

- A. All relevant Contractor-prepared drawings and submittals shall be available for reference during the conduct of each test.

1.09 TEST EQUIPMENT/INSTRUMENT CERTIFICATION

- A. Test equipment/instruments shall be calibrated and accuracy certified within 180 days prior to use. Submit calibration certification with the relevant test reports.

1.10 TEST REPORTS

- A. General: Prepared and submit test reports for review and approval by the District Representative no later than 10 Days after completion of the respective test. As a minimum, the test report shall contain test data sheets, test commentary and a conclusion statement.
- B. Test Data Sheets: Test reports shall include completed test data sheets prepared in accordance with Article 1.06A.14 herein. Completed test data sheets shall contain all site-specific information, test results, and appropriate signatures.
- C. Test Commentary: Prepare a brief commentary on the test. The commentary shall compare the test results and fail/pass criteria, where applicable. In case of test failure, the commentary shall provide an analysis of the test, probable reasons for the failure and remedial measures the Contractor intends to undertake. If failure is corrected during the test, the commentary shall include the corrective action taken.
- D. Conclusion: Provide a concluding statement assessing the success or failure of the test.

1.11 REJECTION AND RETESTING

- A. All equipment shall be examined and inspected thoroughly immediately after the test has been completed.
- B. Failure of equipment to meet the performance requirements, or damage sustained during the test, shall be sufficient grounds for rejection of equipment. Equipment failing to pass the test shall have deficiencies corrected by modifications, if necessary, and be retested without impacting the project schedule unless otherwise approved in writing by the District.
- C. If the modifications or changes affect any drawings, diagrams, software, or other documents previously submitted to and accepted by the District Representative, such drawings, diagrams, or software shall be revised showing the proposed changes and submitted to the District Representative for approval.
- D. The cost of any rework of a unit or system, or the manufacture of a new unit or system, including retesting and witnessing by the District, shall be borne by the Contractor.

Part 2 – PRODUCTS

Not Used

Part 3 – EXECUTION**3.01 FACTORY TESTS**

- A. Factory tests shall verify equipment compliance with performance, reliability, and safety requirements and applicable standards and codes. Factory tests shall begin only after the following requirements have been met:
 - 1. The design of the equipment has been approved by the District Representative.
 - 2. The specific test procedures to be used for factory testing have been approved by the District Representative.
 - 3. Current, up-to-date copies of all contract drawings pertaining to the system or equipment being tested shall be made available to all test attendees.
- B. Factory tests, classified into design, production and system tests, shall be performed as required to satisfy the following requirements:
 - 1. Design tests shall be performed on the first assembled equipment or system component of a given type. The purpose of a design test is to demonstrate compliance to the specified functional and performance requirements of these Specifications, or applicable industry standards.

2. Production tests shall be performed on every completely assembled item of equipment, system component or subsystem to verify the quality and correctness of the manufacturing and assembly processes.
 3. System tests shall be performed as specified in the factory test requirements for individual items of equipment, devices, or systems within the Contract Specifications Sections of those components or systems.
- C. For uniform simple components manufactured in large quantity, such as contact rail sections, coverboard sections, and insulators, factory tests shall be conducted on batch samples. The batch size and sample selection procedure shall be in accordance with the requirements of the Contract Specifications, or if not specified, shall be submitted for approval by the District Representative.
- D. No equipment shall be shipped to the field until the appropriate factory test reports have been submitted and approved by the District Representative.⁷

3.02 **FIELD TESTS**

- A. Field tests shall verify the quality and workmanship of the installation, calibrate and adjust control and protective devices, demonstrate the proper functioning of the various systems and interfaces (including the interface with the existing BART system), and prove compliance of all equipment to the performance, reliability, and maintainability requirements as defined in these Specifications.
- B. Perform the required field tests in accordance with approved test procedures and schedule, except that the District reserves the right to direct the Contractor to change the test sequence or the hours in order to accommodate the District's revenue service and other requirements. This shall be done at no additional cost to the District.
- C. Field tests, classified into installation verification, functional, performance and systems integration tests, shall be performed prior to acceptance of the work.
1. Installation verification tests shall be performed upon completion of the installation of the equipment or system in question. Depending on the nature of the equipment or system, a variety of approaches may be required to verify that the installation has been completed in accordance with the Contractor's design and the equipment manufacturers' recommendations:
 - a. Installation verification tests for standalone systems such as UPSs, HVAC units, and fire alarm control panels shall be conducted in accordance with the manufacturer's published recommendations.
 - b. Installation verification tests for electrical and communication systems that involve device and inter-cabinet wiring shall be based on Contractor-prepared interconnection diagrams which shall be marked-up to indicate that each wire is correctly terminated and continuity has been verified.
 2. Functional tests shall be performed upon completion of the associated installation verification test. Functional tests shall be performed as specified in

the field test requirements for individual items of equipment, devices, or systems within the Contract Specifications Sections of those components or systems.

3. Performance tests, where specified in the related specification section, shall be performed upon completion and acceptance of the associated functional tests, and shall be used to confirm required performance characteristics and capabilities of the tested equipment.
4. System integration tests shall be performed as specified in Contract Specifications Section 20 80 00, Systems Integration Testing.

ATTACHMENT 1 – TO SECTION 20 72 25							
FACTORY AND FIELD TEST OF SUBMITTAL LIST (SAMPLE)							
Division	Section and System	Factory Tests			Field Tests		
		Design	Production	System	Installation Verification	Functional / Performance Test	System Integration Test
14 Conveying Equipment	Section 14 24 00, Hydraulic Elevators	No	Yes	No	Yes	Yes	No
	Section 14 31 00, Escalators	No	Yes	No	Yes	Yes	Yes

END OF SECTION 20 72 25